Safety for rear seat occupants

- We have been looking for ways to further enhance protection in rear seats
- Issues with putting traditional frontal impact airbags in rear seats:
  - Rear seat occupants are typically children
  - Parents are advised to place children in rear seats to eliminate exposure to frontal impact airbags

Question

- Is there a way to bring some of the benefits of frontal impact airbags to the rear seat?

Answer:

Maybe with an Inflatable Belt…

What is an Inflatable Belt?

- A tubular airbag sandwiched between two pieces of shoulder belt webbing

- In the event of a crash, the airbag inflates across the chest in 10 – 20 ms

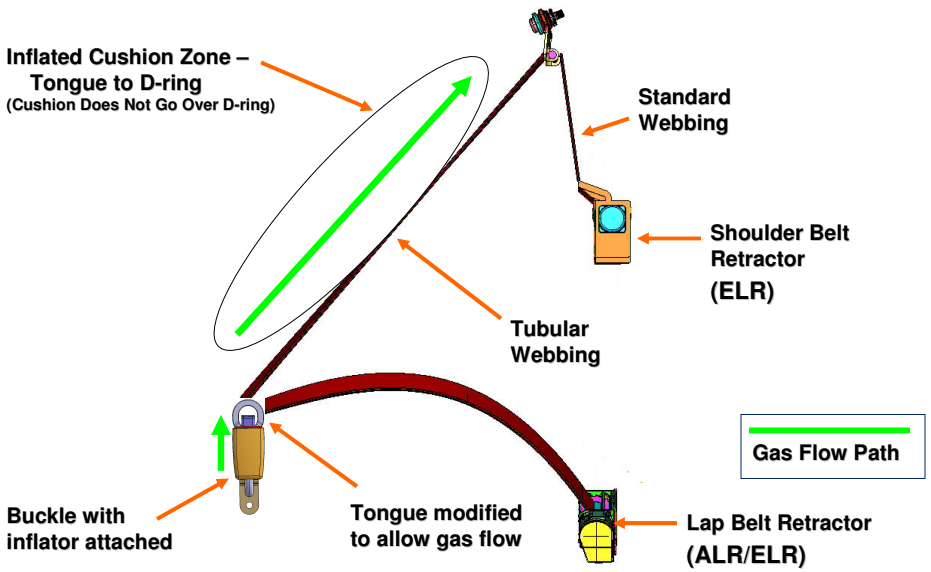
IB Potential Benefits

- Inflation of the airbag portion of the belt and the associated increased size, pretensioning, and load-limiting should:
  - help reduce occupant head excursion
  - help limit occupant neck loads
  - help distribute belt load over more of the chest, reducing pressure & risk of chest injury

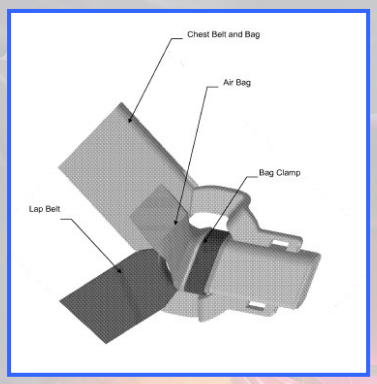
IB Potential Benefits

- May help enhance protection in frontal impacts, side impacts, and other crash modes
- May bring some benefits of frontal impact airbags to the rear seat with less risk of unintended consequences
- May have benefits for all occupants, but especially children, smaller occupants, and elderly occupants

Current System Configuration

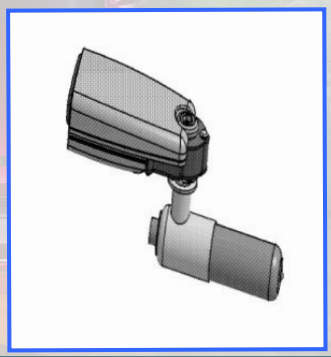


Component Detail

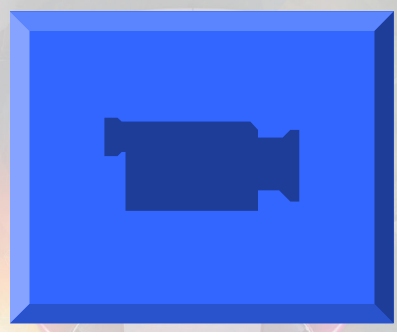


Latch Plate

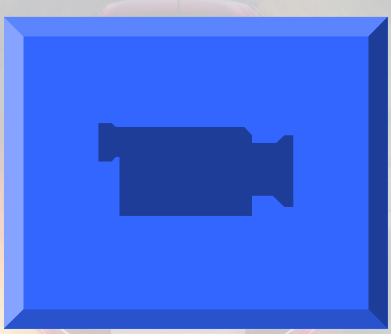
Buckle and Inflator



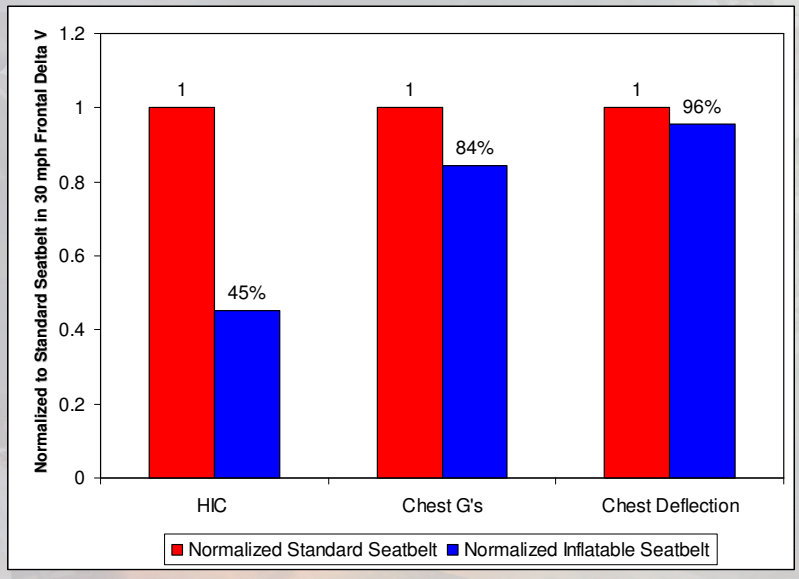
Inflation Sequence Animation



Sled Test Video



Rear Seat Passenger 6 yr Old Dummy Results



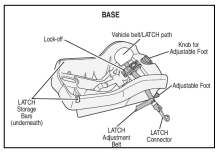
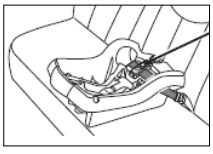
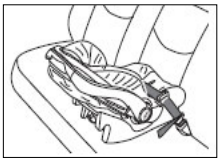
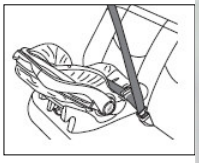
Child Seat Installation & Structural Integrity with Inflatable Seatbelts

CRS Installation
- Potential IB/CRS Interaction

Lap/shoulder belt routed through RFIS base
Shoulder belt routed around infant carrier in RFIS w/o base
Lap/shoulder belt routed through Rear Facing Convertible
Lap/shoulder belt routed through Forward Facing Convertible
Lap/shoulder belt routed through Combination

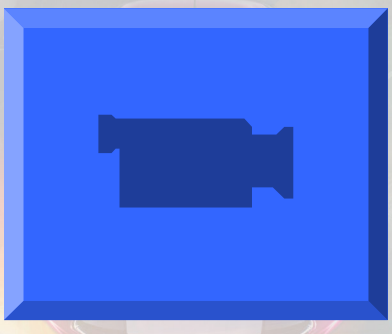
Exemplar - RFIS

Graco Snugride 32 Manual

	LATCH	Lap Belt	Lap/Shoulder Belt
Carrier w/ Base			
Carrier w/o Base	NA		

Model #
Rear Facing Infant Restraint
Max Weight 32 lbs

Child Seat Tests - RFIS



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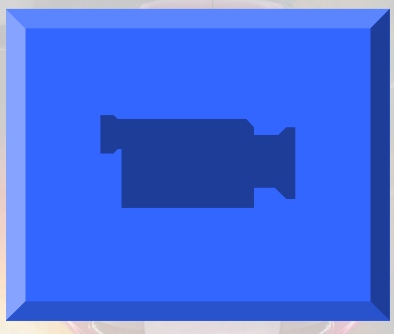
Child Seat Tests - FFCRS



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Child Seat Conclusion

- Child seat integrity is maintained when an inflatable seatbelt is deployed

Ongoing Actions:

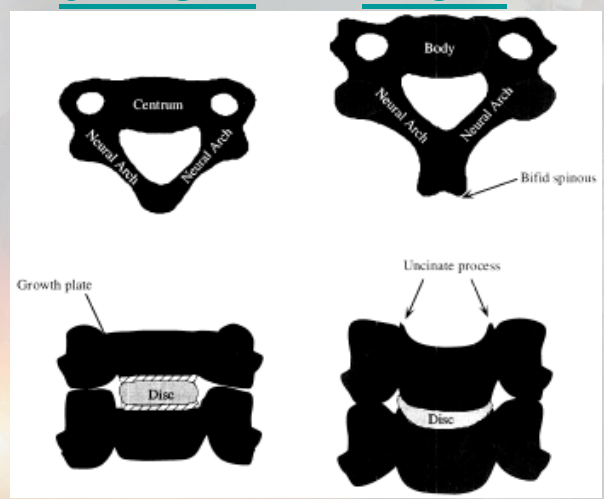
- Presented results to JPMA
- Ongoing discussions with child seat manufacturers to include installation instructions in the manual

What about a Child Sleeping with his/her Head on the Inflatable Seatbelt?

What about children asleep on the belt?

- Sleeping Child

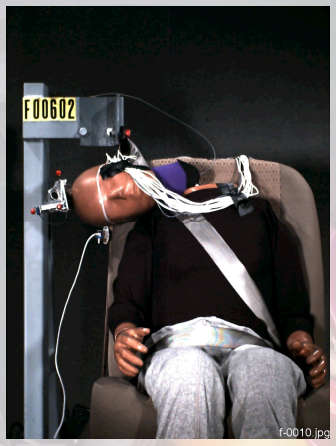
Neck Anatomy – 6 YO vs Adult

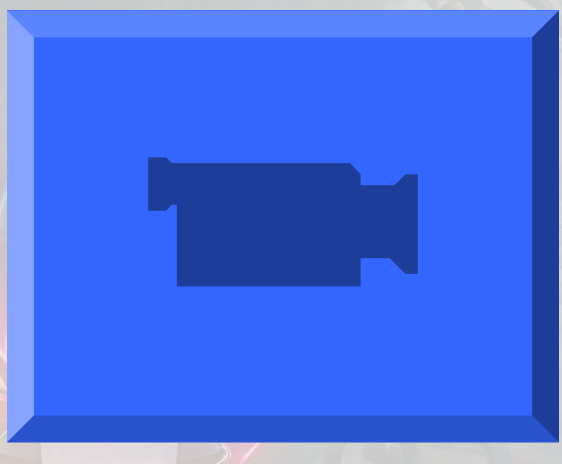
	6 YR OLD	ADULT
Superior View of Cervical Vertebra		
Anterior View of Cervical Vertebra		

Reference: Kumaresan et al. [3]

Note the well developed bilateral uncinate processes and the bifid spinous process.

5th & 6yr Old HIII





All the neck measurements were lower than the Injury Assessment Reference Values (IARV)

Tests of PMHS in Sleeping Child Posture

- Static deployment of inflatable restraint system with seated female PMHS (3 subjects)
  - Prior to the bag deployment, subject's head was rotated and neck flexed so that the lateral surface of the head was in contact with the belt
  - No neck injuries were induced from belt contact or lateral bending

A Ford First – Inflatable Seat Belts!

- Going Into Production on:
  - 2011 Model Year Ford Explorer
    - Introduction in mid Model Year
  - Optional in 2nd Row Outboard Seats